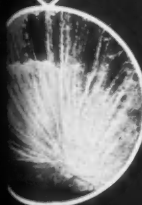


CHEMISTRY



MARCH
1956



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Iron in Colonial America.....	1
Back Cover Picture: Iron in History.....	6
Anti-Neutron Will be Produced.....	7
Advances in Fusion Research.....	11
Atomic Time and Cosmic Spectroscopy.....	15
If the Bombs Fall.....	18
Heat Flow Churns Rocks.....	23
For the Home Lab: Ammonia.....	24
Zirconium Has Bright Future.....	27
Fluoridation Builds Better Teeth.....	29
Chemicals Govern Health and Disease.....	31
New Cancer Detecting Methods.....	34
Relaxing Drugs Help Many Ills.....	37
Chemical Attacks on Insect Foes.....	41
Inventions For the Modern Age.....	44
Book Condensations.....	47
Proudly Presented.....	48

Editorial:

Iron Ages, Then and Now
Inside Front Cover

50¢

★ A SCIENCE SERVICE PUBLICATION ★

Iron Ages, Then and Now

➤ IRON to the ancients was the metal of Mars, the god of war. The Greeks has a legend of the golden age before iron was discovered, when everyone was happy and war was unknown. Philosophers, however, even then pointed out that it is not fair to blame the metal for violent deeds done with it by man.

Iron is the metal of knives, swords and lances, but it is also the metal of cooking pots, shears and horseshoes. It helped civilization get under way. The art of metallurgy was furthered by developments for both peace and war. In very recent time, the first successful type-writer was manufactured by the company that made the Remington rifle. Only gunsmiths had the skill to fabricate iron to the close tolerances that the writing machine required.

The metallurgy of the seven metals known to the ancients is very simple. Gold, silver and copper, of course, occur uncombined. As for the others, their oxide or sulfide ores can be reduced by roasting in contact with air. Not until chemistry and electricity were added to man's resources did it become possible to win the multitude of other metals from the earth's crust.

Today new metals compete with iron. Aluminum, magnesium, beryllium, lithium, titanium, hafnium have now found their peculiar uses.

The one particular property of iron which allowed man to discover a new world by guiding his ships out of sight of land has even been duplicated by new knowledge of science. No longer bound by accidental discovery of lodestone or by meticulous tempering of the metal, man can even make magnets now without iron. But magnetism, the peculiar property of iron, which has been exploited for some 500 years, is just now opening doors to further research in the mysterious new fields within the atom.

CHEMISTRY

Vol. 29, No. 7

Formerly Chemistry Leaflet
Including The Science Leaflet

March, 1956

Published monthly, September through May, by Science Service, Inc., the non-profit institution for the popularization of science, Publication Office: 326 W. Beaver Ave., State College, Pa. Entered as second-class matter at the Post Office, State College, Pa., under Act of Congress of March 3, 1879. Address subscriptions and editorial communications to the Editorial Office: 1719 N Street N.W., Washington 6, D. C.

\$4 a Year; Two-Year Subscription \$7; Your Own and a Gift Subscription \$7 a Year. 50c a Copy except \$1 a Copy for May issue. Ten or more subscriptions to the same address: \$2.90 a Year each. Subscriptions preferred for full volumes only, September through May inclusive; back copies sent. No charge for Foreign or Canadian Postage.

Editors: WATSON DAVIS and HELEN MILES DAVIS

Consulting Editor: PAULINE BEERY MACK (Editor 1927-1944)

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Science Service is the educational and scientific institution organized in 1921 as a non-profit corporation with trustees nominated by the National Academy of Sciences, the National Research Council, the American Association for the Advancement of Science, the Scripps Estate and the Journalistic Profession.

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► IRON for early American colonists was produced at Saugus, Mass., before 1650. This model, reproducing the furnace which has been reconstructed there, shows how the Hammersmith iron works in that New England community looked.

Iron in Colonial America

by HELEN M. DAVIS

► CONSCIOUS of the early and continued importance of iron in daily life, the iron and steel industry of America is leading the industrial world in telling its part in American history.

At Saugus, Massachusetts, the site of one of America's earliest iron works, the equipment which began to turn out iron there for the New England colonists three hundred years ago has been duplicated as an educational exhibit. Models of that restoration have recently been installed as part of the iron and steel exhibit in the National Museum in Washington, under the direction of the Smithsonian Institution.

They show iron making as a hand craft practiced by the earliest European settlers on this con-

tinental, and how its methods progressed as it met the needs of our expanding civilization.

Other old sites where iron was made in colonial times have been explored by iron men with an appreciation of the past. At Hopewell, Pennsylvania, buildings and furnaces have been reconstructed to show how iron was produced there a century or so later than at Saugus.

Other iron works were constructed all over the country, from the time of the Jamestown, Va. settlement on, and more will doubtless be rebuilt in the future.

Requirements of the iron-making industry were complex. They led to the formation of self-contained communities which Professor Arthur C. Bining of the

University of Pennsylvania, historian, calls "iron plantations".

Occurrence of the iron ore determined the location of the iron plantation. The ore, in the early days, was usually limonite, the bog iron ore still found in considerable quantity along the eastern seaboard of the United States.

The "great house" of the iron plantation was the residence of the iron master. Clustered around it were cottages of the workers, who mined the ore, quarried limestone for the flux, burned charcoal for the fuel, worked up the iron into manufactured articles and kept a store where these articles were sold.

In addition to these activities peculiar to the iron business, other people were kept busy by the farm work necessary to feed this bustling community. Woodcutters had to fell trees to make the charcoal. As the forests were consumed, iron foundries moved west into the mountains. Thus the iron industry played a part in the westward movement that settled the United States.

Early methods of winning the metal from the ore, as practiced at Saugus, Mass., and at Hope-well, Pa., could produce both cast iron and wrought iron. They were essentially the same as the most up-to-date methods used in Europe at the time. "Slitting mills" were widely used here to produce the ribbons of soft iron which

were worked up into nails and wire. They were, it is said, the latest thing in iron working equipment.

Most of the equipment in the early iron works was built of the stone occurring in the locality. Methods for producing iron necessarily varied with the materials at hand. Ideally these materials should, in addition to the ore, be limestone to melt the charge and form the slag, and charcoal for fuel. It was many years before coke made from coal supplanted charcoal.

Modern iron historians who worked on the project of restoring the plant at Saugus were puzzled by the lack of limestone in the neighborhood. They were further puzzled by evidence that a local rock called "gabbro", a granite-like formation containing a very small quantity of iron, was used in the Saugus furnaces. Analytical chemistry solved both these puzzles. Slag recovered from the ancient waste-piles at Saugus proved to have the same composition as that produced in an experimental mix of 40 percent gabbro combined with 60 percent bog iron ore. Lacking limestone, the colonists "made do" with the low melting point silicates of the gabbro. The rock's iron content, insofar as it contributed to the yield of metal, was just a bonus.

Formation of suitable slag is the most important chemical reaction

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► COMMUNITIES centered around the early iron works, which themselves required a number of buildings for their various activities. This photograph shows the restored site of the Hammersmith plant at Saugus, Mass. Many iron works were established in the colonies. Their products served local needs, and each furnace is estimated to have had about thirty regular customers.

in reducing iron ore to metal. Ores of iron are in general oxides or sulfides. Their reduction is relatively easy, as metallurgical processes go. But other elements beside iron are present in the minerals that charge the furnaces. The most critical of these are silicon, sulfur, phosphorus and carbon. Each modifies the properties of iron in its own way, and a small difference in the quantity of each makes a large difference in the resulting metal. One of the requirements of slag is that it incorporate the undesirable excess of such elements into its liquid make-up.

Sharp separation of the two products of the iron-making furnace results in two liquid layers. The lower, heavier layer is nearly pure iron. Floating on top of this layer is the slag, primarily calcium silicate, containing other basic elements in varying amounts. The blast furnace is so designed that these two liquid

layers may be drawn off separately, through vents at different heights from the floor.

The iron in the lower layer always contains a small amount of silicon in solution. A high silicon iron contains about one-half of one percent of this element. Low silicon iron may contain one-tenth as much as that. Silicon makes iron harder, and additional amounts, up to 2 percent or even a little more, may be used when manganese, chromium or vanadium are added also. Springs are often made of hard, tough high-silicon steel.

Carbon makes the difference between iron and steel. Chemical combinations of carbon with iron takes place at blast furnace temperatures. The compound is soluble in molten iron, and increases the hardness of the metal after it has solidified. Iron containing less than 1.8 percent carbon is classified as cast iron.

Cast iron is described as "white"

when carbon has not separated out as minute flakes of graphite, and as "grey" when graphite is present. Wrought iron as produced by early workers was more malleable and less brittle than cast iron. It has largely been replaced by steel in its many varieties, produced by modern machinery with better understanding of how these variations come about.

While silicon and carbon in the right proportions improve the properties of steel, sulfur and phosphorus are considered harmful elements. Their percentages are kept below certain critical levels, as both have a tendency to separate out, making weak spots in the beams, rails or other structures in which they are incorporated. They also make the steel itself more brittle.

Manganese, a metal whose compounds are found in small amounts in a large number of places, is one of the most important regulators of the composition of steel. It sweeps excess sulfur, phosphorus and oxygen out of the molten iron into the slag in the blast furnace. It also helps carbon combine with iron instead of burning up. Manganese also dissolves to some extent in the steel, increasing its hardness. In addition to these useful properties, manganese sometimes occurs ready-mixed with iron, in oxide minerals.

Oxygen, hydrogen and nitrogen, introduced as air and water vapor, are present in the blast furnace as gases. They are sometimes trapped as bubbles when iron solidifies, making dangerously weak spots. These formerly were almost impossible to detect until they were revealed by failure of the structural member where they were hidden. X-ray devices have been developed for monitoring steel products, to spot such secret flaws.

All the foregoing ingredients were part of the early iron worker's experience, whether or not he recognized them all. In the years since the remote iron plantation fell into disuse, many new developments have changed the iron industry.

Limonite was the ore worked by the early colonists. It is a hydrated oxide of iron, dark reddish brown in color, occurring in rounded lumps. Other important ores are the blood-red hematite and the blue-black magnetite. The latter is the "lodestone", which introduced mankind to iron's mysterious property of magnetism.

Discovery of enormous deposits of these ores farther west, especially the Mesabi Range in Minnesota, built up the newer phase of the iron industry in America which centered around Pittsburgh, Pa. and the Great Lakes.

Ore boats and railroads brought

1800-1865: EXPANDING MANUFACTURE FED ON IRON



► *Tools for the arts of peace, and weapons of war were turned out by the growing iron industry during America's historic years. This is one of the exhibits showing the history of iron, just installed at the U. S. National Museum.*

the essential ore to plentiful supplies of limestone and coal, and steel branched out from building railroads to making the skeletons for America's skyscrapers.

Metal working demanded harder tools. Metallurgy of iron grew to include that of a number of heavy metals, including nickel, cobalt, chromium, vanadium, molybdenum and tungsten. The general effect of adding any of these metals to steel is to make the resulting alloy harder, but each of the heavier elements produces its own kind of "tool steel". Modern stainless steel, and the new kinds of very powerful magnets, also come from alloys of these elements which combine with iron

to make the special steels.

The effect of heat treatment, followed by slow or sudden cooling, on the hardness, strength and "springiness" of steel was discovered by accident thousands of years before systematic study of steel's composition explained the reasons. The explanation lies in the various kinds of alloys and solid solutions of metals and their carbides which are stable at the temperatures reached. It is interesting to guess in the light of such modern knowledge what accidents of materials and treatment might have produced the "magic swords" that are prominent in ancient legends.

Since the reduction of iron ore

to metal was successfully accomplished in handcraft eras long ago, and by early colonists in America whose resources were not much different from those of the Stone Age Indians whose country they shared, how did they do it? Could the modern do-it-yourself enthusiast make iron in his backyard barbecue pit?

Early iron makers in America were not without power machinery to help them, crude and feeble as those machines seem now. Iron needs a very hot fire. The colonial metallurgist used power to produce it.

Mills sprang up in the colonies on every suitable stream of water. A water wheel like those which turned milling machines was built to work great leather bellows that made forced draft for the furnace at Saugus. Day and night the bellows blew the fire hotter. Even with this me-

chanical aid, the iron master had trouble holding his workmen to their heavy, hot, difficult tasks.

Ironmaking is not easy, it requires much additional reheating and reworking after the molten metal is cast from the furnace into the branching sand molds that reminded the farmer-metallurgist of mother sows and their families of pigs.

Pig iron has grown to be an increasingly important American product. Three hundred years after Saugus, one modern blast furnace is charged every 24 hours with as much raw material for steel as would have supplied the little Massachusetts furnace for three years.

As modern iron masters point out proudly, the men of Saugus did more than turn out iron for the early settlers. They established an industry.

On the Back Cover

► IRON RELICS in American history, including this chain which once kept hostile ships out of one of America's important rivers, are included in the steel industry's exhibit in the U. S. National Museum. From early handwrought iron made by the colonists to the latest inventions, the development of this important metal is portrayed. Photographs are through the courtesy of Bethlehem Steel Co.

**New Particle, Anti-Neutron,
Sought by Scientists**

Anti-Neutron Will Be Produced

► A SEARCH for a new particle of negative matter, the anti-neutron, is being launched at the University of California.

The anti-neutron, like the neutron, has no charge. It would annihilate matter in a collision with an ordinary neutron, the particle that keeps atomic reactors going.

Since the anti-neutron has no charge, its negative properties result from reversal of the tiny particle's magnetic poles.

Techniques for producing and detecting the anti-neutron are known and it is only a question of time before it is discovered, Dr. Emilio Segre said.

Scientists attending the American Physical Society meeting at the University of Southern California learned of the hunt for the new particle of anti-matter at a symposium on the anti-proton, whose discovery was announced on Oct. 19.

To make an anti-neutron, scientists will hurl an anti-proton at an atomic heart, then watch for the tracks made by the anti-neutron when it annihilates matter.

Anti-protons are produced from energy at the rate of about one every 15 minutes in Berkeley's

giant bevatron. They are negatively charged particles of the same mass as protons, and are found only in high energy nuclear collisions such as occur in very powerful atom smashers and in cosmic radiation.

One unexpected property of the anti-proton is its effective size, twice that of the ordinary proton. This size, known as the cross-section, was expected by most scientists to be equal.

This doubling of the cross-section means that matter is much less transparent to anti-protons than to protons, Dr. Segre said.

Other scientists participating in the anti-proton symposium were Drs. C. Weigand, O. Chamberlain and J. J. Murray, all of the University of California, and Dr. R. Serber of Columbia University.

If a star or system of stars made entirely of negative matter does exist, Dr. Segre said, and collided with ordinary stars, a "catastrophe of cosmic proportions" would be produced, with "fireworks the like of which have never been seen."

Anti-Proton Seen

► FIRST visual evidence of the anti-proton, new subatomic particle, is reported by scientists of

the University of California and Rome, Italy. They found one photoemulsion "star," an explosion of the nucleus caused by an anti-proton.

This new particle was discovered at Berkeley in early October as the result of bevatron bombardment, after world-wide search by scientists for several years. The Berkeley discovery was made by precision measurements with counters.

Protons are the positively charged hearts of hydrogen atoms. Anti-protons are their opposite number, having the same mass, but negatively charged.

Annihilation of matter results when proton and anti-proton collide, turning the material particles into bursts of energy according to the famous Einstein theory equating mass and energy.

In collaborative research at the University of California and Rome, emulsion plates were bombarded in the bevatron anti-proton beam at Berkeley. Half the plates have been under study in Berkeley, the other half were taken to Italy for study by Prof. Edoardo Amaldi and colleagues.

One star was observed by the Amaldi group in mid-November and a joint paper describing the event, still unpublished, was written for the *Physical Review*, with names in the following order: Drs. Owen Chamberlain, Warren Chupp, Gerson Goldhaber, Emilio

Segre, Claude Wiegand, all of Berkeley; and Edoardo Amaldi, C. Baroni, C. Castagnoli, C. Franzinetti and A. Manfredini of Rome.

This paper has been read to the Italian Academy of Sciences in Rome by Prof. Amaldi.

The star was made by an anti-proton entering either silver or bromine in emulsion. An eight-pronged star resulted, showing six heavy particles, either protons or alpha particles, and two mesons. Neutrons probably also emerge, but they are not visible.

In past years a number of scientists have observed, in emulsions or cloud chambers, mysterious stars they suspected might come from anti-protons in cosmic rays. According to the University of California, these include Dr. Evans Hayward at Berkeley in 1947; Dr. Bruno Rossi at Massachusetts Institute of Technology in 1954, and Prof. Amaldi and his colleagues in 1955.

However, these stars in nature could not be definitely ascribed to anti-protons. The star now found helps confirm the anti-proton discovery by measurements with counters.

Twice Expected Size

► THE ANTI-PROTON, newly discovered particle of negative matter, is twice the size scientists expected, Dr. Owen Chamberlain of the University of California states.

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He reported to the American Physical Society meeting that experiments in Berkeley's giant cyclotron confirmed this "unexpected" property.

Dr. Edward Teller, also of the University of California, has predicted the future discovery of two new particles, tiny bits of matter that act as glue to bind atomic hearts together.

He said these yet-undiscovered particles are needed to explain the large effective size of the anti-proton.

More examples of the anti-proton are now being found, Dr. Chamberlain reported, as scientists learn exactly where to place the emulsions on which the negative particles register as stars.

The Berkeley group is collaborating with Dr. Eduordo Amaldi and his co-workers at Rome.

One "spectacular" star, found by Dr. Gerson Goldhaber and associates, is especially important. It has eight prongs, with three protons and five pi mesons, or pions. One pion decays into a mu meson and an electron.

Total visible energy of this star is 1,230 million electron volts. It is important because this is in excess of the rest mass of either the proton or the anti-proton, which is 938 million electron volts.

Finding this excess energy gives the best evidence yet that the anti-proton annihilates either a

neutron or a proton. It is demonstrated by the fact that the visible energy exceeds that of one particle.

The difference between 1,230 million electron volts and the 1,876 million electron volts of two particles is in neutral particles not visible emerging from the star.

The anti-proton star first reported by Dr. Amaldi's group showed a visible energy of 826 million electron volts.

The negative particle of matter, for which evidence had long been sought, was discovered by precision measurements with counters by a team of Berkeley scientists. Besides Dr. Chamberlain, the group included Dr. Emilio Segre, Clyde Wiegand and Thomas Ypsilantis.

World's Fastest "Stop Watch"

► THE WORLD'S fastest "stop watch," for clocking the action of atomic particles, has been developed at the Westinghouse Research Laboratories, Dr. Clarence Zener, acting director reports.

Capable of timing atomic happenings down to less than one billionth of a second, the stop watch is an electronic tube called a photomultiplier.

It is so fast that its exact top speed cannot be determined until laboratory measuring instruments catch up with it. Calculations show, Dr. Zener explained, that it is probably 10 times faster

than the one billionth of a second recording.

The electronic stop watch, designed to aid nuclear studies, strengthens weak pulses of radiations and detects the time intervals between them, Dr. Zener said.

It will be used to time the flight of speeding atomic particles.

It will permit us to measure, with a new order of precision, the speed, and therefore, the energy of atomic particles as they "smash" into atoms and produce reactions, or as they are ejected from the atom during such reactions. This precision, we believe, will give us new insight into the causes and effects of nuclear reactions, and, perhaps, into the structure of the atomic nucleus itself, Dr. Zener stated.

The tube was developed by Dr. E. J. Sternglass and Milton M. Wachtel, research scientists at the laboratories.

Atomic Clearing House

► To SIFT information on the atomic nucleus from laboratories all over the world, an "atomic clearing house" has been established at the University of California at Los Angeles.

From the processing of a mass of data by both human and electronic brains, a picture of the atomic nucleus is emerging.

It took less than a pound of coal to produce a kilowatt-hour of electricity in the United States last year.

"Its a rather fuzzy picture," reports Dr. David Saxon, who is directing the group of theoretical physicists at U.C.L.A. trying to find meaning in the mass of data. "But this is apparently because of the nature of the atomic nucleus," he says.

"Our studies have indicated that the nucleus does not have a sharp edge. It is like a ball of yarn with a very fuzzy edge. Or perhaps it is more like a cloud whose trailing edges gradually disappear into the blue."

Dr. Saxon describes the assault on the atom with cyclotrons, linear accelerators and other instruments as like trying to determine the shape of a house in pitch-black darkness by bouncing tennis balls off it.

Neutrons and protons fired by these atom smashers are like luminous tennis balls, he says. By noting the way the balls bounce we are beginning to get an idea of the shape of the atom's core.

SWAC, the Institute for Numerical Analysis' electronic computer at U.C.L.A., is helping to reduce "ball bouncing" data to meaningful mathematical models. Other scientists who have been working on the project are Roger Woods, Michel Melkanoff and John Nodvik.

Advances in Fusion Research

► CONTROLLING the H-bomb's fusion reactions for peaceful purposes without the need of a container able to withstand the tremendously high temperatures required is the aim of studies described to the American Physical Society.

Since supplies of light elements that can be fused or joined together are almost limitless, compared with supplies of uranium and other fissionable materials, scientists in many laboratories in the United States, England, Europe and India are attacking the problem of taming fusion reactions.

To make light elements fuse, temperatures of many thousands of degrees are required. Such temperatures are found in the sun and other stars, and when uranium or plutonium are fissioned or split in an atomic bomb.

But generating the required heat in a controlled manner means having containers that will not melt or be otherwise affected.

A new approach, eliminating the container problem is to use the so-called "pinch effect." J. A. R. Samson and Dr. R. E. Vollrath, of the University of Southern California, reported to physicists their experiments on using this

effect to obtain high temperatures for fusion in a gas column that touches no walls.

Atomic Energy Commission scientists are believed to be working along similar lines, but their work is shrouded in secrecy.

The pinch effect is the name given to the contraction of an electric current due to its own magnetic field. This shrinking occurs in any liquid or gas carrying a current, such as the familiar neon tube, but is usually much too small to be noticeable.

When large enough currents are used, however, the current will pull itself into a thin thread, and can even cut itself off.

As the gas contracts, it shrinks from the walls until the thinning column is its own container, completely out of contact with the sides.

Dr. Vollrath and Mr. Samson are experimenting with hydrogen gas under very low pressure. A single surge of electricity is sent through the gas contained in a doughnut-shaped tube to "excite" it or raise its temperature.

By examining light emitted by the excited hydrogen, they have detected the beginning of contraction or pinching. Exactly what temperatures are obtained is not

yet known, since their experiments are still in the preliminary stages.

The pinch effect was first noted by E. Northrup in 1907, when he was studying conduction of electrical currents in liquid mercury. Its application to gaseous discharges is an entirely new viewpoint that may, it is hoped, one day lead to controlled power from fusion of light elements.

Still in Future, AEC Says

► THE PEACEFUL use of the H-bomb reaction is many years in the future, the Atomic Energy Commission assures Congress in its nineteenth semiannual report.

After confirming existence of research on controlled thermonuclear research at five laboratories, the AEC declares that many years of intensive theoretical and experimental research will be needed before there can be produced the first form of a machine using light elements as atomic fuel.

Human cancer is being attacked with the protons, hearts of hydrogen atoms, in experiments reported from the University of California at Berkeley. Cyclotron-produced protons were used on 30 patients, including 28 in advanced stages of cancer of the sort that may be benefitted by pituitary inactivity. The proton treatment caused good suppression of pituitary function and a number of the patients obtained considerable relief.

Doses of ionizing radiation that produce moderate incapacity can reactivate latent epidemic typhus infections, research on monkeys at the Johns Hopkins University School of Public Health has shown. The AEC sees the possibility of this being a health hazard that might complicate the aftermath of a very heavy exposure of densely populated areas to nuclear bomb radiation.

Heavy ionizing radiation may actually improve the learning process, at least in rats. Irradiated animals at the University of Nebraska are reported to learn more rapidly and forget more slowly in standard puzzle situations for rats. It seems that this is not a true basic improvement in the learning process, however, but rather that the injured animals are less subject to incidental distractions.

The world's first pound of the extremely rare element, europium, has been produced at Oak Ridge National Laboratory. An extraction process using tributyl phosphate and nitric acid was used to produce 500 grams, the largest known single quantity of this element. Europium will be used in control rods in atomic power plants.

Yttrium, another rare earth metal, will be available in relatively large quantity, since 150 pounds of its pure oxide is being converted to metal at Ames Laboratory.

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A way to mix atomic fuel with molten metal for use in power plants of the future is reported from Argonne National Laboratory. A slurry can be made by suspending uranium dioxide in liquid sodium-potassium alloy.

By using radiation to induce mutations in plants, the AEC reports Brookhaven scientists have produced a high yield wheat that is resistant to one form of wheat rust, a variety of rice with short strong straw to withstand wind damage, and a disease-resistant flax.

Test H-Bomb in Sub-Antarctic

► BRITISH and Australian scientists will explode the British Commonwealth's first hydrogen bomb in an uninhabited area of the sub-antarctic regions.

"Trigger" A-bombs will be tested at Monte Bello Islands, 800 miles northwest of Perth, West Australia, in March and at the Maralinga proving ground in the South Australian desert in November.

The "trigger" bombs, it was reported, will start a chain reaction in the H-bomb and finally explode it.

Scientists have already tested a "trigger" bomb near Woomera rocket range in Central Australia. The result of the "trigger" bomb tests this year will be used to reduce the weight and increase the power of the H-bomb.

It is expected that the made-in-England H-bomb will be flown from Britain by RAF V-bomber to the new 8,000-foot airstrip at Maralinga which will take the largest planes in the world.

The H-bomb will be flown from Maralinga and dropped over its target in the southern ocean.

American observers may attend both the "trigger" bomb tests and the H-bomb tests later. Australia, Britain and the United States are now discussing whether U. S. observers will attend.

Supply Minister Howard Beale announced the formation of a 25-aircraft task force of British and Australian planes for the Monte Bello tests to fly daily from mid-February over the Timor Sea from Darwin on the lookout for tropical storms.

The test, it is expected, will be held soon after that period when weather conditions become favorable.

Germany Enters Atomic Field

► DETAILED construction plans for the first industrial atomic power plant in Germany are now available.

The construction of the first plant will commence as soon as the German Parliament has passed the atomic energy law, which is being prepared by the German Atomic Energy Authority, it was reported in Bonn.

Building contractors will be the

German Babcock and Wilcox at Oberhausen in the Rhineland. The reactor for the plant will be of uranium-graphite-moderated type. It is reported that 90 to 100 tons of natural uranium ore will be necessary for the operation of the plant, whose cost is estimated at almost \$10,000,000.

Germany does not have a suf-

ficient amount of uranium at her disposal to operate the plant and plans are that it will be bought abroad. It has been suggested to "breed" with the reactor about 600 pounds of plutonium during the first five years of operation, thereby securing the fissionable material for reactors of a more common type planned to be built.

Radioactive Gems Point to Uranium

► BY EMBEDDING zircon jewels in the thick photographic emulsion used for finding tracks of radioactive rays, alpha particles have been located shooting off in three dimensions from the semi-precious gem stones. The source of the alpha particles is probably uranium or thorium crystallized with the zircons, scientists state.

Radioactivity has only recently been recognized as a property of zircons, Drs. I. H. Ford and C. D. Ollier of the department of geology of the University of Bristol, England, explained. They devised the plan of burying the gems in the nuclear emulsion in order to measure the relationship of the radioactive rays to the total surface of the zircon particles. Activities as high as 250 alpha particles per unit area of the gems have been found.

Uranium and thorium often occur together with the element

zirconium in zircon crystals, the Bristol scientists state. Hence their method of photographing small crystals of zircon can be used to assay the probable amount of the atomic power minerals to be expected in nearby rock.

After sprinkling the photographic plates with grains of zircon and pouring liquified photographic emulsion of the same sort over them, the plates were "exposed" for 20 days in a light-tight box in a refrigerator. Processing the plates revealed alpha particle tracks in three dimensions surrounding and in contact with the gems. Zircon is probably one of the first minerals to crystallize when rocks cool from the melted state, the Bristol scientists observe. They believe that their studies will throw light on problems of the origin of minerals and the formation of uranium and thorium deposits in them.

More than half of the drugs in use today were unknown 17 years ago.

Atomic Time and Cosmic Spectroscopy

▶ **WHETHER** astronomical clocks keep the same time as atomic clocks will be checked within five years, Dr. G. M. Clemence, director of the U.S. Naval Observatory's Nautical Almanac Office, predicted at the Atlanta meeting of the American Association for the Advancement of Science.

Each clock keeps time by an entirely different method. One depends on observations of the stars, the other on the millions of vibrations each atom of the element cesium makes every second.

This is the first time in history, Dr. Clemence said, that two basic timekeeping standards have been available for comparison. Each can be measured with an accuracy of one part per 1,000,000,000 or better.

One result of such a comparison could be an improved value for the speed of light, which is now known accurately only to one part in 10,000.

Another result might be the discovery that atomic time is continuously accelerated with respect to astronomical time.

Even if this did happen, Dr. Clemence said it would not necessarily refute Einstein's theory of relativity, which holds as fundamental the belief that the velocity of light is constant.

It would, however, have great and far-reaching effects on basic physical theory and on astronomers' present ideas of the structure of the universe.

Dr. Clemence warned that widespread use of atomic time might lead to confusion. He suggested use of the term "essen" to designate the second as measured by atomic vibrations, keeping the commonly used word, second, to designate astronomical time.

Astronomers have recently changed the basis of measuring a second, Dr. Clemence pointed out. It no longer takes 86,400 seconds to make a mean solar day.

A second is now defined as a 31,556,925.975 part of the tropical year, which corresponds to the seasons, for 1900.0. This new measure of time is known as ephemeris time.

It was adopted because gradual increases in the precision of astronomical observations and improvements in man-made clocks have shown that the earth's rotation rate, by which the old second was measured, varies. It is, therefore, unsuitable as a precise standard.

The new second is based on the period of the earth's revolution around the sun, and has been officially recognized by the Interna-

tional Committee on Weights and Measures.

Expanding Universe Shown

► NEW EVIDENCE of the expansion of the universe is given by radio microwaves measured here on earth after arrival from the tremendous collision of two vast stellar systems like our own Milky Way.

With the 50-foot radio telescope atop the Naval Research Laboratory, Anacostia, D.C., two scientists, Dr. A. Edward Lilley and Edward F. McClain, tuned in on the radio noise of the sky's second "brightest" source of radio waves, called Cygnus A.

They found that the frequency of these 21-centimeter waves is shifted toward the red end of the spectrum by what is considered the recession or rushing away of the gigantic galaxies. This corresponds to the red shift or Doppler effect discovered in light from the same galaxies.

Both light and radio waves are caused by the energy of collision of the hydrogen gas molecules in the clashing stellar systems.

The galaxies are rushing away with the expansion of the universe, which is greater the farther away from us. At the Cygnus A distance of a hundred million light years (light traveling in a year at 186,000 miles per second) the velocity of recession is approximately 10,500 miles per sec-

ond for both radio and light waves. This is presumably an actual flying apart of the universe. The optical velocity was determined at Palomar Observatory after the location of the radio "star" had been obtained by British and Australian radio astronomers.

The correspondence of both the light and radio effects makes scientists more confident they are dealing with expansion effects not some change in fundamental laws with distance.

Glowing Gas Absorbs Radio Waves

► DISCOVERY that radio waves are absorbed by one mass of glowing gas in the heavens known as an emission nebula is reported by three Australian radio astronomers.

The Australian discovery means that radio astronomers can isolate individual objects by their absorption of certain energy bands in the radio region, just as optical astronomers now analyze a stellar composition by absorbed light.

Although only one emission nebula, NGC 6375, has so far been thus isolated, larger radio telescopes now being built or planned should result in similar discoveries for other objects.

Drs. B. Y. Mills, A. G. Little and K. V. Sheridan of the Commonwealth Scientific and Industrial Research Organization, Sydney, Australia, report the first case of absorption of radio waves by

an emission nebula in the British scientific journal, *Nature*.

They used the 1,500-foot radio antenna at Sydney to study 14 nebulas at a wavelength of three and a half meters, or about 11 and a half feet. (Shortest radio waves from commercial AM stations are measured in hundreds of feet.)

Six nebulas were observed in emission, seven were not detected at this wave length, and NGC 6375 was found to be an absorber.

Astrophysicists thus have a method of learning about the physical characteristics of emission nebulas without depending on optical measurements made unreliable by obscuring dust between the earth and such objects.

The Australian scientists estimate the absorbing nebula's temperature as 6,500 degrees Kelvin, somewhat lower than that usually assumed from optical measurements.

Position of the nebula, they found, is in good agreement with previous optical sightings and with its location based on radio waves about an inch long, which, only last year, scientists at the Naval Research Laboratory, Washington, D.C., discovered being broadcast by the object.

Faint Airglow Detected

► SPECIAL instruments that detect the upper atmosphere's very faint airglow even in full moonlight will scan the sky from at least

four stations during the International Geophysical Year.

Dr. E. R. Manring of the Air Force Cambridge Research Center, Sunspot, New Mexico, said the studies were aimed at discovering what causes the peculiar glow, so faint it can be spotted only with special instruments.

Airglow is the word used to describe the self-luminescence of upper atmospheric gases. It is present every night everywhere on earth, but is of such low intensity it cannot be seen by naked eye as auroras can.

A new device, first operated earlier this year, should allow tracing one of the elements responsible for airglow even during daylight hours, Dr. Manring told a symposium on the International Geophysical Year.

The symposium was the second of three being held by the American Association for the Advancement of Science outlining plans for U.S. participation in IGY, a world-wide study of the earth, its seas and air scheduled for 1957-58.

Before the new instrument was developed, starlight and scattered sunlight interfered with the records scientists want to get. Now they can map the entire sky in less than four minutes, recording separately the light emitted by three of the elements thought to cause airglow.

If the Bombs Fall

► IRONICALLY, lives can be saved if the dead are counted quickly following a nuclear attack on the United States.

This grim fact was reported recently by Dean Pohlenz, deputy assistant administrator for planning of the Federal Civil Defense Administration, in revealing plans to use electronic "brains" to assess the nation's losses after an attack.

Electronic computers, he said, proved in recent tests that they may be the answer to systematically assess the number of fatally injured, surviving injured, dwelling units damaged and other information for the more than 50 "target cities" in the nation.

Hand figuring can be dangerously slow. The sooner we know how hard we have been hit, he said, the faster we can begin to recover.

Their use, he pointed out, might work this way to compute the destruction of homes: operating from a central headquarters, the attack factors are set up on the computer. Assuming that a single weapon was used, factors are the size of the weapon, the height of the burst, and "ground zero" of the explosion. These factors become coordinates for figuring damage.

The computer scans the area around ground zero and quickly determines the number of homes destroyed, printing out the figures faster than the eye can read them.

Mr. Pohlenz also revealed that the Atomic Energy Commission and the U.S. Bureau of Standards are at work developing a special computer technique to determine fallout patterns.

Although test results are not conclusive so far, he explained, we feel reasonably sure that fallout can be figured by computers.

In still another direction, Mr. Pohlenz reported that government agencies are developing a system of automatic transmission for post-attack information to reach computer headquarters.

Both the post-attack computing "brain" and automatic transmission systems are being developed by the Stanford Research Institute.

When A or H Bombs Fall

► EVACUATE vertically, either up by aircraft or down into basement shelters, when thermonuclear bombs start going off. This advice was given by Lt. Col. S. E. Lifton, Air Force Medical Corps and special weapons defense officer to the Surgeon General of the Air

Force, at a meeting of the Association of Military Surgeons of the United States.

Lateral evacuation, that is along the ground, may be "walking from the frying pan into the fire," if multiple bombs are dropped, Col. Lifton said. In other words trying to get away from one bomb by walking, running or driving, may bring the evacuees into the radiation fall-out of another bomb.

For the military, it will only be necessary to remain in shelters for a critical few hours, he said. This is because of the rapid rate of decay of radioactive fall-out. As an example of how military personnel could continue to operate, he said that if the mission of an Air Force base calls for aircraft to take off, the base could go underground during several hours of active fall-out. Then the support personnel could come out to prepare planes and return underground. At this point the air crews, which have remained in the shelter, could come out and start on the mission with comparatively little delay, despite fall-out.

Jump Behind Wall

► JUMPING behind a wall will help protect you from burns from a fusion bomb, though it will not in case of an atomic bomb.

The reason is that fusion bombs give off radiant energy that will

produce burns for up to about 15 seconds. Atomic bombs, or fission bombs, produce radiant energy burns chiefly within the first two-tenths of a second and no burn at all after the first five-tenths of a second, so there is not enough time to jump behind a shielding structure in the case of these bombs.

These differences were pointed out by Capt. Donald W. Miller of the Navy Medical Corps, chief of surgery at the U.S. Naval Hospital, Newport, R.I., at the meeting of the Association of Military Surgeons of the United States.

In treating badly burned patients, treatment of the burn surface is of secondary importance, Capt. Miller declared.

First thing that must be done is to give blood and fluid to combat shock. There is, he pointed out, a rapid shift in distribution of body fluid and salts when a considerable area of the body is burned. Fluid quickly collects in the tissues under the burn and there is considerable loss of fluid that exudes from the burn surface. This fluid comes from other body tissues and from the blood. The blood gets more concentrated and there is less of it circulating through the body.

Fluid with salts in the same proportion as in normal body fluids must be given to replace that being lost.

Capt. Miller advises exposure

treatment, that is leaving the burns uncovered after gentle cleaning, in preference to compression bandages. The exposure treatment saves time, expense, reduces infection and consequent need for skin grafting, and the patients are more comfortable after the first 24 hours.

Antibiotics in large doses and a diet high in calories, protein and vitamins are needed by burn patients. In the early stages, they must be watched for breathing difficulty and tubes put in the throat if necessary. Suction tubes into the stomach may also be needed to overcome the stomach dilation when there are burns over 30% to 50% of the body area.

With this type of treatment, 93% of the burn casualties from the U.S.S. Bennington disaster survived 25% to 50% second and third degree burns and 79% survived 50% to 75% second and third degree burns.

Can Reverse Damage

► THE BONE marrow damage which causes hemorrhages and death in victims of radiation can be reversed.

This has been found in studies of Siamese twin animals. The studies were shown in an exhibit by the Department of the Navy at the meeting of the Association of Military Surgeons of the United States.

The studies were made by Dr.

Eugene Cronkite at the Naval Medical Research Institute, Bethesda, Md., and Dr. George Bricker of the National Institutes of Health, Bethesda. Dr. Cronkite is now at the Atomic Energy Commission's National Laboratory, Upton, Long Island, N. Y.

The Siamese twin animals were attached from shoulder blade to hip. This caused some mixing, or cross circulation, of blood of the two animals. The amount was not massive. Dr. Bricker described it as "a trickle."

One of the twin animals had been exposed to irradiation. The other had not. The "trickle" of blood from the non-irradiated animal was enough to stimulate or speed recovery of the bone marrow that had been damaged by radiation in the other twin.

It did this, the scientists think, because there exists in the normal body some "humoral factor" which can speed formation of new bone marrow.

It would be "delightful," Dr. Bricker said, if this humoral substance could be isolated and put in capsules that all of us could carry for use in the event of an atomic or H-bomb attack. Unfortunately this is not likely to become possible. Some of the material has been isolated by English scientists but it loses its activity except when handled and stored under very special conditions. Even adding a bit of dis-

tilled water destroys its activity.

Since, however, it is now known that bone marrow destruction can be reversed, there is hope of finding some practical way for doing it.

No Ray Injury Antidote

► NO ANTIDOTE for radiation injury for humans exists at present and there is no early probability of one being developed, Commander E. P. Cronkite of the Naval Medical Corps, declares.

Much has been learned about the course of radiation injury. Much has been learned, he said, about how to speed recovery "at the experimental level." But he declared flatly that "there is nothing that is clinically practical for use on human beings on any scale at the present time."

Wounds and other injuries and heat burns, he said, will dwarf radiation injury as a practical problem in the event of attack with nuclear weapons.

Doctors are learning that in mass care of casualties they must comprise with ideal methods in order to do the most good for the largest number. These compromises include saving stores of blood and plasma for those casualties who will benefit from it and not wasting any on those certain to die regardless of what can be done for them.

Gas Gangrene Toxoid

► A TOXOID for immunizing people against gas gangrene is being

developed at the University of Cincinnati, Col. Herbert W. Coone, Air Force Medical Corps and chief of professional services at the USAF Hospital, Wright-Patterson Air Force Base, Ohio, has revealed.

Such a toxoid, he pointed out, would be the "major hope" for suppressing or preventing gas gangrene infections among the mass casualties of atomic warfare.

Even in Korea, such infections were more prevalent than had previously been believed likely. This was partly due to inexperience with the infections and consequent inability to recognize them on the part of otherwise highly skilled surgeons.

Under conditions of shock and delayed debridement of wounds which occur in mass casualties, antibiotics may be less effective than gas gangrene toxoid immunization for stopping this serious wound infection.

More Bomb Tests in 1956

► BIGGER and better A-bomb and H-bomb explosions are forecast for the world in 1956.

Four nations — the United States, Russia, Britain and Australia — will test their own nuclear and thermonuclear weapons this year.

The tests will be held in or near the Pacific Ocean, which is rapidly becoming the world's a-

tomic proving ground. The United States and joint British-Australian tests are scheduled for the spring. It is reported that Russia will also continue its weapons' tests during 1956.

This country will resume testing both hydrogen and atomic bombs at the Eniwetok Proving Ground in the Pacific. It is expected that new models and devices of both weapons will be tested at the Pacific Proving Ground this spring. Eniwetok was the site of the historic detonation of the H-bomb on March 1, 1954.

Two series of atomic bomb tests by the British are scheduled in Australia.

The first will take place in April at the Monte Bello Islands off northwest Australia and the second at the newly constructed Maralinga proving ground in Australia and 500 miles west of the Woomera guided missile testing site.

The Australian explosions will be small, described as a few tens of kilotons in yield. The tests will include new detonating systems, atomic weapons other than bombs

and guided missiles with atomic warheads.

It has also been reported in both England and Australia that Britain has a made-in-England H-bomb and will test it at sea sometime in 1956.

Russia, which detonated its largest H-bomb to date recently, is expected to continue its nuclear and thermonuclear tests. The Soviet's proving grounds have been placed somewhere in or near Siberia.

Japanese scientists believe that Russia's testing site is on Wrangel Island, which is inside the Arctic Circle due west of American Point Barrow in Alaska. Other observers report that the Soviets have a proving ground at Kamchatka, due west of Attu in the Aleutian Islands.

Despite talk of disarmament and the fear expressed by many of the world's scientists that excessive nuclear and thermonuclear explosions could be dangerous, there is still much to be learned. Technological advances made by a country's scientists on paper still have to be tested.

Crabgrass, the lawnmaker's perennial enemy, is now being controlled with phenyl mercury acetate and potassium cyanate.

Nine hundred million red blood cells are manufactured in the human body every day.

Little is known about the basic mechanisms that hold dirt to clothes and other surfaces.

Heat Flow Churns Rocks

► THE EARTH'S interior is slowly churning over in giant blocks hundreds or thousands of miles in size, a scientist suggests.

Dr. Roger Revelle, director of the Scripps Institution of Oceanography, La Jolla, Calif., likened the snail-paced over-turning to tar mixing in a barrel heated from below. The motion is "incredibly small," he told the American Physical Society meeting, "about one mile in 100,000 years."

Radioactive heating at great depths is thought to cause rocks deep beneath the surface to flow upward in some places and downward in others, he said.

This internal heat is of fundamental importance in shaping the earth's surface. Volcanoes, earthquakes, mountain ranges and deep-sea trenches all result from slow convulsions within the earth produced by the heat's escape.

The total amount of heat coming from the earth's interior is only about a ten-thousandth of that falling on the earth's surface from the sun.

A search is being made, Dr. Revelle said, to see if a pattern exists in the quantity of heat flowing outward from different areas.

One pattern may have been found near the Great Acapulco Trench off Central America,

where the heat flow is very low. Yet 500 miles to the west, where there is a great ridge on the sea floor, the heat flow is twice the average value.

Cold rocks may be moving downward under the trench and warm rocks moving upward under the ridge, Dr. Revelle told the physicists meeting at the University of Southern California.

It is possible that, even though heat is being generated within the earth, the outer layers have cooled since the earth's formation, Dr. Revelle said.

In doing so, they have contracted or shrunk, something like the skin of an apple when it dries. On this theory, mountain ranges and deep trenches are wrinkles produced by shrinking.

The radioactive elements, uranium, thorium and their disintegration products, as well as an isotope of potassium, are the heat sources within the earth.

Under the continents, most of the heat is probably generated in the outer 20 miles of the earth's rocky crust, since rocks in this outer layer are relatively high in radioactivity. Rock samples from oceanic islands and rocks dredged from the deep-sea floor are low in radioactivity.

For The Home Lab

Ammonia

by BURTON L. HAWK

► MANY YEARS ago, some observant soul noticed that a gas with a sharp stifling odor was produced when the hoofs and horns of animals were heated, and that this gas would dissolve easily in water. The solution thus obtained was called "spirit of hartshorn" and can be considered the ancestor of modern ammonia water. Ammonia is produced in nature when any nitrogenous organic material decomposes in the absence of air.

Place a few crystals of plain gelatin in a dry test tube. Apply gentle heat, trying not to scorch the material. See if you can detect the odor of ammonia at the mouth of the tube. Be sure to remove the tube from the flame before you do any sniffing. Because there are other products given off at the same time, the ammonia may be difficult to detect. Moisten a piece of red litmus paper and hold it at the mouth of the tube. It will turn blue, indicating the presence of alkali (ammonia?).

If you have a few spare fingernails that need cutting, place the trimmings in a dry test tube and add a small quantity of lime (calcium oxide or hydroxide). Heat

again, as above, and test with litmus paper.

The first pure ammonia was probably prepared by Priestley, about 1774, by heating sal ammoniac with lime. Place a small quantity of ammonium chloride and an equal amount of lime in a dry test tube. Again heat and smell cautiously after removing from the flame. This time you will have no trouble in detecting the ammonia!

Before we prepare ammonia in quantity and investigate its properties, we would like to include a word of caution. Even though ammonia is used to strengthen fainting ladies and revive the unconscious, don't forget that it will also operate in the reverse. For if you inhale too strongly, it will knock you out! Remember, too, ammonia is very irritating to the eyes. Perform these experiments in well-ventilated surroundings, and keep your face a safe distance away!

The most convenient way to prepare ammonia in the laboratory is by adding ammonium hydroxide to solid potassium hydroxide. Use an Erlenmeyer flask as the generator. Place about 2 pellets in the dry flask. Close the flask with a two-hole stopper containing thistle tube and glass tub-

ing arranged to collect the gas by downward displacement of air (see Fig. 1), Add enough ammonium hydroxide through this tube to completely cover the pellets and be sure the end of the thistle tube is entirely immersed in the liquid. The action should proceed quite vigorously by itself as pure ammonia is produced. If the reaction is slow it may be necessary to apply gentle heat. Just be careful not to heat too strongly! Collect a few bottles of the gas, as shown in the illustration. The delivery tube should extend nearly to the bottom of the inverted receiving bottle or flask. When you estimate the flask is filled with ammonia (*estimate . . . don't smell!*) carefully remove it keeping it upside down. Ammonia is lighter than air and it will stay in the flask as long as you hold it in an inverted position. Place the flask upside down on the table.

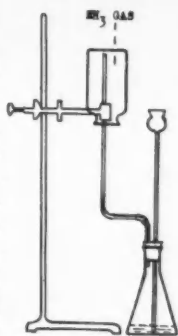
Ammonia is very soluble in water. Take one of the flasks of ammonia and place it—still inverted—in a pan of water. After a while the water will rise up inside the

flask, drawn up by the greedy ammonia.

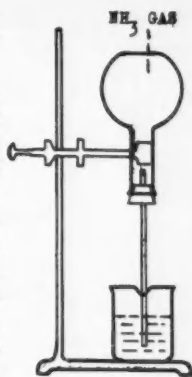
A more spectacular way of demonstrating the solubility of ammonia is by the popular ammonia "fountain" experiment. Simply attach a one-hole stopper and glass tubing to a flask of ammonia gas. Keeping the flask upside

down immerse the tube in a beaker of water containing a few drops of phenolphthalein solution (see Fig. 2). The water will rise up the tube and when it reaches the ammonia flask will gush forth as a fountain until the flask is filled. The water will turn red, due to the phenolphthalein indicator added. If you like, red litmus solution may be substituted. Then you will have a blue fountain. The water rises in the tube very slowly, so be patient! If it does not rise after a reasonable length of time, then you do not have sufficient ammonia in the flask. Collect more and try again.

Ammonia is also an effective reducing agent. Place some black copper (cupric) oxide in a test tube and apply heat. Place the



➤ FIG. 1. Collecting ammonia by downward displacement.



➤ FIG. 2. The ammonia fountain.

delivery tube from your ammonia generator about $\frac{1}{2}$ inch above the oxide in the tube. Soon you will note the black powder is turning reddish-brown as it is reduced first to cuprous oxide and then to metallic copper.

Still another example of reduction by ammonia can be shown by a sympathetic ink experiment. Write on a piece of filter paper with a solution of mercurous nitrate using a glass rod or a tooth pick. Allow to dry. The writing will be invisible. Now hold the paper near the outlet tube of the ammonia generator. The writing will suddenly appear in black characters. The ammonia has reduced the mercurous solution to metallic mercury.

Finally, take another bottle of ammonia. Turn it right side up and quickly add a few drops of hydrochloric acid and shake. Note the thick clouds of smoke forming in the flask. This "smoke" consists of tiny particles of ammonium chloride. You can create many "magic" tricks with this reaction. For example, pour a bottle of invisible hydrogen chloride gas (made by heating common salt

with sulfuric acid) into a bottle of invisible ammonia gas. Thus two apparently "empty" bottles produce smoke. Or you can moisten a piece of cotton with HCl and hold it near the mouth of a bottle of ammonia and observe smoking cotton without flame.

Of course, we do not have to elaborate on the usefulness of ammonia. It is used in huge quantities in the production of important ammonium compounds for industry and fertilizers, and is itself an important refrigerant. Further, it is oxidized to produce nitric acid which in turn is used to manufacture a host of nitrate products.

Ammonia is now produced synthetically from the nitrogen of the air and the hydrogen from water. This method was devised by the German chemist Haber during World War I to manufacture the explosives so badly needed. This is a remarkable achievement when we consider the multitude of ammonia and nitrogen compounds that can be obtained by using as the starting raw materials two abundant materials: air and water!

About 20% of U. S. high school graduates receive bachelor degrees and only 2% of those judged mentally capable of obtaining a Ph.D. do so.

In terms of power alone, the strength of a man in prime health is worth much less per day than the cost of a single cigarette.

British scientists are using television to watch conditions inside a nuclear reactor.

Zirconium Has Bright Future

► THE NEW METAL "with the bright future," zirconium, has graduated from laboratory oddity to large-scale commercial production, following ten years of intensive research and experimentation, the U. S. Bureau of Mines has revealed.

Zirconium's properties make it a desirable construction material in the field of nuclear energy, the Bureau reported. Almost as strong as steel, but lighter, it is resistant to corrosion and has an extremely high melting point of 3,350 degrees Fahrenheit. Most grades of steel melt below 2,800 degrees Fahrenheit.

It is used in building atomic ovens, since it does not absorb, and thus waste, neutrons needed to sustain a chain reaction. The metal was a vital material in the production of the first atomic submarine, the Nautilus.

Until last year the Bureau of Mines was the principal supplier of zirconium used by the Atomic Energy Commission and the Navy Department's Bureau of Ships. Now the Bureau has handed the production job over to private industry and is working on research aimed at increasing zirconium's usefulness, according to the report.

Commercial production of the

metal began in 1945, using a technique developed by Dr. William J. Kroll, a metallurgist who escaped to this country from his native Luxembourg before the Nazi invasion. In this process, molten magnesium is used to "win" the pure metal from the compounds it is found in naturally.

Zirconium absorbs impurities from the air, so that extracting and melting it must be carried out in a vacuum. It is "temperamental," and will burst into flame during certain stages of production unless handled carefully.

In 1948, when the AEC became interested in the metal, there was one pilot plant already operating capable of producing 3,000 pounds of sponge metal a year. Later, that Bureau-operated plant came to produce more than 280,000 pounds a year.

Hot Rolling For Hafnium

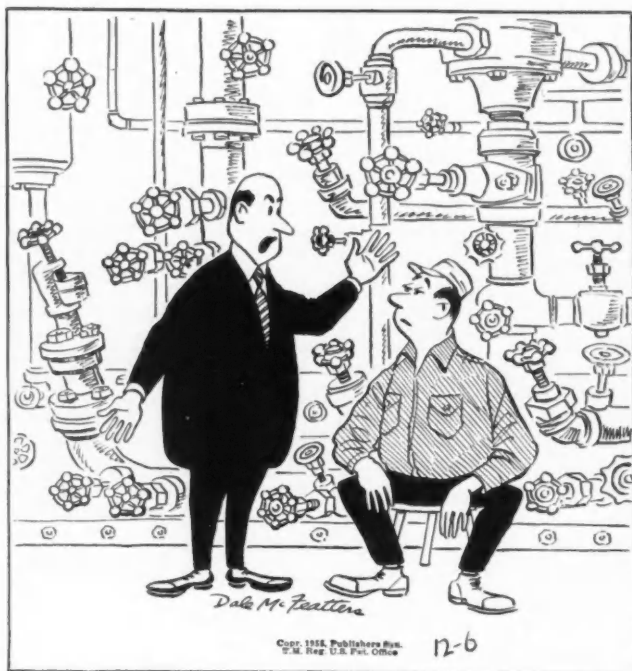
► HAFNIUM, rare metal similar to titanium and zirconium, can be rolled to any desired thickness if heated to 500 degrees Centigrade (932 degrees Fahrenheit), it has been found at the Missouri School of Mines and Metallurgy. Use of the metal has been limited heretofore by its tendency to crack when cold-rolled.

Discovered in 1923, hafnium

has been a chemical curiosity until, as a result of the program to use atomic energy, metals have been re-evaluated according to their capacities of absorbing neutrons. Zirconium has been found suitable for constructing atomic power reactors but hafnium, which occurs with zirconium, has a different ability.

In this respect, U.S. Bureau of Mines scientists are working with

Atomic Energy Commission scientists to find uses for the rarer metal, obtained as a by-product of increasing zirconium production. They furnished samples of hafnium to D. S. Eppelsheimer and D. S. Gould of the School of Mines. The results of the metallurgical experiments which show hafnium to be corrosion-resistant and to have a high melting point, were reported in the British scientific journal, *Nature*.



► "Now don't forget—if you turn the wrong valve... Boom"

Fluoridation Builds Better Teeth

► THE 30,000-population Hudson River town of Kingston, N.Y., can now end its 10 years of service as a guinea pig for science.

It can now, if it wishes, start adding small amounts of fluorine to its water supply to improve the teeth of its children and future citizens. For 10 years, since May, 1945, Kingston has kept its fluoride-free water supply, while its neighbor town, Newburgh, N.Y., added 1.0 to 1.2 p.p.m. of fluorine to its water supply. Newburgh, in a sense, was a guinea pig town, too.

Newburgh has reaped the reward in tooth decay reduction of its children. But Kingston for the entire 10 years had to continue its non-fluoridated water status so that there would be a suitable control for this large scale scientific trial of a now widespread anti-tooth-decay measure.

The final results were reported to the New York Institute of Clinical Oral Pathology at the New York Academy of Medicine.

They show that fluoridation is "safe and effective," Dr. Herman E. Hilleboe, Commissioner of the New York State Department of Health, declared.

Children aged six to nine in Newburgh who had been drinking fluoridated water all their

lives had a 58% lower DMF rate for permanent teeth than the Kingston children of the same age. The DMF rate, meaning rate of decayed, missing and filled teeth, is usually taken as the measure of tooth decay.

Even older Newburgh children who did not drink fluoridated water all their lives but who lived continuously in Newburgh for the 10 years of the experiment had a lower decay rate. For those aged 10 to 12, the rate was 52% lower, for the 13 to 14-year-olds it was 48% lower and for the 16-year-old group it was 41% lower.

So far as safety is concerned, it was reported that a lethal dose of fluoride is some 600 times greater than the amount found in a gallon of fluoridated drinking water. Even if by chance the whole day's supply of fluoride for a city were to be added in one hour instead of in 24 hours, there would still be a safety factor of a hundred-fold.

The Newburgh and Kingston children were given general medical examinations as well as dental examinations. No differences of medical significance could be found between the two groups.

Against Tooth Decay Acids

► AFTER screening more than 2,500 chemicals in a search to find

substances which might protect teeth from acids formed in the mouth from sugars and starches in the diet, Dr. R. S. Manly of Tufts University School of Dental Medicine reported two chemicals to the meeting of the American Association for the Advancement of Science.

The two chemicals described by Dr. Manly are composed of short chain fatty acids combined with unsaturated compounds of carbon rings of five and six carbon atoms. Such compounds will receive further study. Dr. Manly was aided in this research by Gladys Hargreaves, Junior Research Associate.

Anti-Caries Role for Mucus

► **REPULSIVE** to many, the mucus in spit, or saliva, nevertheless may have an important role in preventing tooth decay. This is shown in studies by Dr. C. E. Klapper and associates at the University of Alabama Medical Center.

Most of the saliva in the mouth is produced by three pairs of glands, Dr. Leon H. Schneyer of the university's dental school found. These are the submaxillary glands located below the angle of the lower jaw, the sublingual glands under the tongue, and the parotid glands in front of the ears, which are the ones that swell in mumps.

Dr. Klapper put Syrian hams-

ters on a diet that is known to produce tooth decay in these animals. Then he tied off or removed all the saliva-producing glands in one group of these animals. Another group had only the parotid glands tied off. A third had only the under-tongue glands removed. The fourth group had only the under-jaw glands removed.

The tooth decay scores after 70 days of the decay-producing diet were highest for the group with all saliva-producing glands removed. This showed that the saliva produced by the parotid glands played little or no part in protecting against tooth decay. The other glands still in the mouth were keeping the decay down.

The under-tongue glands which produce the smallest amount of saliva, only five percent of the total, were more effective in protecting against tooth decay than the parotid glands which produce 25% of the total saliva.

The reason, Dr. Klapper reports, is in the difference in composition of the saliva produced by the different glands. The parotids produce exclusively a clear fluid type of saliva. The under-tongue glands produce only the mucus of saliva. The under-jaw glands produce some of each.

The mucus of the saliva, he concludes, probably played a more important role in preventing tooth decay than the serum part.

Chemicals Govern Health and Disease

► THE PATTERNS of movement, in the gastrointestinal tract, of water and a group of mobile minerals, important in heart disease and shock, have been worked out for the first time by scientists in the University of California School of Medicine, San Francisco.

The minerals are sodium, potassium, bromine and chlorine. The atoms of these minerals lose electrons easily, and when missing an electron they can move rapidly and participate readily in chemical reactions in the body.

These electrolytes are critically important in shock, starvation and exposure. In shock sodium migrates from normal body reservoirs to the wound, and treatment includes replacement of the lost sodium.

In congestive heart failure and high blood pressure there are severe changes in water and mineral metabolism, but the mechanisms are not known.

An understanding of these disturbances has been lacking because of the absence of accurate data on normal metabolism of water and minerals.

Using radioactive and heavy isotopes, the California researchers have determined the normal metabolism, as the baseline of

studies of the abnormalities that occur in disease and injury. The work was done with rabbits.

The scientists found that water and electrolytes are not bound to other minerals in the gastrointestinal tract, and they diffuse freely between the stomach, small bowel, cecum and large bowel.

For example, in a matter of three hours water is completely diffused in the gastrointestinal tract, while the electrolytes take several times longer.

The research, supported by the American Heart Association, was done by Dr. I. S. Edelman with the participation of Drs. Norman J. Sweet, Judith Nadell and Frank A. Gotch.

Metals Stop Viruses

► METALS in special combinations stop certain viruses by attacking on the rear, Drs. L. M. Kozloff and K. Henderson of the University of Chicago have discovered.

The tails of the viruses are shortened by treatment with the metal combinations. The viruses are then inactivated. They lose their ability to attach themselves to their host, they cannot kill their host and they cannot reproduce.

The viruses on which this discovery was made are some of the

ones that prey on larger organisms, bacteria, and are called bacteriophages.

When a virus of this kind invades a bacterial cell, the virus attaches itself by its tail, apparently making a hole in the wall of the bacterial cell.

Short-tailed viruses apparently cannot do this.

Mercuric mercury can shorten the virus tails by itself. Zinc and cadmium, however, can only do it when in special combinations with other materials. These combinations are known technically as complexes.

The findings are reported in detail in the scientific journal, *Nature*.

'Flu Virus Needs Sugar

➤ INFLUENZA viruses like sugar, even if the sugar isn't sweet. Some other viruses go for vitamins or for metals such as copper.

Many viruses contain fatty chemicals, indicating perhaps a fatty kind of diet. All viruses need proteins such as those found in the nucleus of every cell.

Virus diet needs were described by Dr. James V. Moulder of the University of Chicago at the recent meeting of the American Association for the Advancement of Science.

Knowing what the viruses must feed on helps scientists stop the viruses by fooling them into accepting a chemical very like the

ones they need but enough different to block their reproduction, Dr. Moulder explained.

Seek Diseases For Viruses

➤ ORPHAN viruses, many of them discovered in studies of suspected poliomyelitis cases, now number 13. They have been renamed ECHO viruses and they are "in search of disease." To put it another way, the scientists who know about these viruses are seeking specific diseases the viruses cause.

Announcement of the 13, where and by whom discovered and whether they were found in sick persons was made in the journal *Science*. Some were found in healthy children, others in children with aseptic meningitis, often diagnosed as nonparalytic polio.

The name Orphan for viruses in search of disease was first suggested "in a moment of conviviality" by Dr. F. Duran-Reynals of Yale University School of Medicine, New Haven.

The new name ECHO is made of the first letters of scientific terms which describe the viruses more exactly, Enteric, (meaning intestines where the viruses are found), Cytopathogenic (meaning they attack body cells), Human and Orphan.

ECHO viruses have been found in Egypt, Connecticut, Maine, Rhode Island and the Philippine Islands.

The 13 have been tested and found distinct from each other and from the three known polio viruses, the Coxsackie viruses, and the viruses of fever blisters, influenza, mumps, measles, chickenpox, ARD and APC viruses, all of which also have been found in human intestines.

The 13 are neutralized by human gamma globulin and by individual human blood serums. This means they infect human beings. They can be grown in cultures of monkey kidney cells.

The latest information on them is announced by the Committee on ECHO viruses of the National Foundation for Infantile Paralysis, of which Dr. J. L. Melnick, Yale University, is chairman.

Stops Desire For Alcohol

► TREATMENT with a gland extract or hormone might be the way to curb or even abolish an alcoholic's craving for drink.

The treatment works in rats. A very few observations made in a beginning trial on human alcoholics suggests that it might work for them, too.

Thyroid extract or thyroxine are the gland chemicals that do the trick in rats, Dr. Curt P. Richter of Johns Hopkins Hospital, Baltimore, reported at the meeting of the American Associa-

tion for the Advancement of Science.

Dr. Richter gave his rats thyroid extract because he was trying to induce a craving for alcohol in them. That would have given him laboratory animals for study of alcoholism.

Thyroid extract greatly increases the rats' appetite for sugar, he found. But it has just the opposite effect on their appetite for alcoholic beverages. Given a choice of water, alcohol, wine or whiskey, the rats preferred water. They either greatly reduced their intake of the alcoholic beverages or stopped drinking them altogether. Refusal of beer was not so striking. That may be because it has some carbohydrate in it which the thyroid extract would make the rats like as they like sugar.

Hyperthyroid patients, that is patients whose own thyroid glands are producing excessive amounts of hormone, very rarely are alcoholics, Dr. Richter pointed out. So he thinks a small daily dose might stop the alcoholic's craving for drink.

Trial of this new treatment is starting under the direction of another scientist. So far, too few patients have been observed for any report.

Radioactive carbon is helping scientists find out why dirt sticks to cloth and other materials.

See Thick Blood Serum
Giving Test For Cancer

New Cancer Detecting Methods

► A NEW and simple blood test to detect unsuspected cancer is being evaluated by the National Cancer Institute at Bethesda, Md.

It may prove to be the long-sought test for mass detection of cancer that could be used as chest X-rays are for detecting tuberculosis in the population. Cancer Institute scientists, however, have not yet gotten far enough with their evaluation procedure to be able to tell whether the new test will be that good or whether it will suffer the fate of other proposed cancer tests which failed in the rigorous evaluation.

The test depends on a thickening blood serum found in cancer patients but not in persons without cancer. Discovery of this difference was made by Drs. James A. Quinn and Arthur E. Rappoport and bacteriologist Stanley A. Katz of the Youngstown (Ohio) Hospital Association. The "distinct differences" in the blood serum of cancer and non-cancer patients can be easily measured by optical methods. The Youngstown scientists used an instrument called the Coleman Jr. spectrophotometer for measuring the optical density of the blood serum. But they feel sure other

similar instruments could be used.

In a study of over 1,700 cases, the new test was at least 90% accurate, the scientists state in a report to the American Society of Clinical Pathologists.

Negative reactions, meaning no cancer, were obtained in 466 (97.7%) of 479 normal persons. Negative results were also obtained in 817 (86.3%) of 944 non-cancerous patients sick with other diseases. False positive results came chiefly in persons with acute and chronic inflammations and in pregnancy. In 313 patients with proved cancer, the test gave true positive results in 282 (90.1%).

Since the tests on these groups, the Youngstown scientists have made the test on another 3,500 persons, with results continuing to be consistent and encouraging.

Besides picking up early cancer and the hidden and obscure types that often are not detected in routine medical examinations, the test may be valuable for telling surgeons whether a cancer has been completely removed or whether a bit has been left and continues to grow and spread.

The scientists were surprised to find that the test gave best re-

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sults in cases of early cancer. If cases of advanced cancer were eliminated from those on whom the test was tried, the test would have an accuracy of 96.5%.

Why the blood serum should have a different density in cancer patients is not known. Further study on this, the scientists say, is needed.

Negative Response

► A NEGATIVE response to stimulation by a hormone will help detect hard-to-diagnose early cancer of the pancreas, is the hope of Drs. Martin M. Nothman, Joseph H. Pratt and Allan D. Callow of the New England Center Hospital and Tufts Medical School, Boston.

Research supporting this hope was reported by the three at the Boston meeting of the American Medical Association.

The pancreas is best known as the insulin-producing organ of the body. Cancer of the pancreas makes up about five percent of all cancers and takes sixth place in frequency. It is a type of cancer which tends to spread.

The pancreas also is a source of an enzyme chemical called lipase. When injections of the pancreas-stimulating hormone, secretin, are given to normal persons, more lipase is excreted in the urine. When given to cancer patients, the secretin failed to result in increased lipase excretion.

In seven patients with cancer, the secretin injections resulted in decrease or disappearance of lipase. This was the only test, the doctors reported, which supported a diagnosis of cancer of the pancreas in these patients. The fact that they did have such cancers was later proved when surgeons operated and found the cancers.

Try Two Viruses

► VIRUSES, usually feared as causing polio and other diseases, may be the means of stopping an even more feared disease, cancer.

Hope for success in this attempt appeared in the biennial report of the Sloan-Kettering Institute for Cancer Research, New York.

Scientists there and at Memorial Hospital have started treating very sick patients with far advanced cancer with two viruses. One goes by the name of Egypt 101. The other is a new virus never before tried as an anti-cancer weapon. Its name is still a secret. In the near future several more viruses will be tried in human cancer patients.

Because the treatments have only just started, no results can be given. Those who have followed closely the efforts of cancer fighters may remember there was hope a few years ago of stopping cancer with viruses. Efforts along this line were "stymied" for a

time. One reason was that the scientist in charge of the work, Dr. Chester Southam, was called to duty in the armed services.

Meanwhile a big step in cancer fighting was taken. This was the finding of ways to grow human cancers outside the human body. The earlier virus-against-cancer work had been done on animal cancers. Scientists now know that every kind of cell has its own particular chemical needs and susceptibility to injury. Mouse cells differ somewhat from rat cells and both from human cells. More than that, liver cells of one species differ in chemical needs from intestinal cells of the same species.

As a result of such advances, scientists were able to grow the two potential anti-cancer viruses in human cancer cells instead of

in animal cancer cells. This, they think, gives them a much better chance of making the viruses destroy the cancers in the bodies of human patients.

Viruses, it has long been known, can kill some kinds of cells while leaving others unharmed. Polio virus, for example, kills cells of the brain and spinal cord.

The viruses now being used have been worked with and changed so that their ability to destroy cancer cells, especially human ones, has been increased. At the same time any ability they had to injure any normal cells has been decreased.

The crucial step now is to see whether these viruses which can kill human cancer cells outside the body can do the same in the body of the patient.

Flame-Proofing Treatment For Cotton

► A FLAME-PROOFING treatment for cotton materials, much superior to previous methods, has been developed jointly by the U.S. Department of Agriculture scientists and the Army Quartermasters Corps' research branch.

To produce cotton cloth that passes the most rigorous tests for flame resistance, a combination of two chemicals that up to now were used separately for flame-proofing cotton is employed in the new technique.

In the treatment, one part of BAP (bromoform-allyl-phosphate) is added to two parts of THPC-resin solution (tetrakis-hydroxymethyl - phosphonium chloride), and applied to the cloth which is then dried and heat-cured. This process increases the weight of the cloth about 18%, but shows little effect on other fabric qualities. Flame resistance holds up well under both laundering and dry cleaning.

**Snakeroot Remedy
For Hallucinations**

Relaxing Drugs Help Many Ills

► THE SNAKEROOT drug from India can banish the "little men on the ceiling" of delirium tremens faster than any other treatment for this alcoholic condition, it appears from a report to the Journal of the American Medical Association.

The drug is reserpine, widely used in mental sickness and high blood pressure. Its ability to control hallucinations in patients with acute head injuries led to its trial in 24 patients with delirium tremens.

Most of the 18 men and six women were the type of chronic alcoholics seen in a charity hospital. Because of their excited state and fear of "snakes," "little men," "bugs" and "two-headed elephants," they had to be kept in firm restraints.

Within six to eight hours after getting the reserpine they began to quiet down. They stopped seeing snakes and the like in an average of 18 hours.

Most of the patients were completely free of symptoms within 24 hours. For two, relief came in nine hours.

These results are reported by Drs. Milton Avol and Philip J. Vogle of the College of Medical Evangelists and Los Angeles

County, Calif., General Hospital at Los Angeles.

The speedy recoveries with reserpine treatment, compared to the four to six days needed for recovery by other treatments, lead the Los Angeles doctors to say they feel reserpine holds great promise in treatment of this condition.

They gave the drug in much larger doses than those used for high blood pressure patients. Since the d.t. patients could not be induced to take it by mouth, it was injected either into the muscles or the veins. No ill-effects were seen in spite of the relatively large doses.

Seek Less Costly Drugs

► EFFORTS to reduce the cost of tranquilizing drug treatment so more patients can have it are being made at the Manteno, Ill., State Hospital.

Using a mixture of several active alkaloids from snakeroot plants, *Rauwolfia*, is one way to do it, Drs. William J. Gallagher, John M. Berry, W. D. Durden and William D. Lazenby of Manteno reported at the meeting of the American Association for the Advancement of Science.

Men with chronic schizophrenia, they also found from this and other studies, respond more slowly to reserpine than do women with the same mental disease.

Reserpine from Rauwolfia was given to one group of patients. Another group got a Rauwolfia alkaloid mixture containing 75% reserpine and 25% recanescine, called Riker 529-1, and a second mixture, of 75% reserpine and 25% rescinnamine, called Riker 529-2. A third group got 11-desmethoxy reserpine. Some of this group also got iproniazid to prolong the effect of free serotonin released by the desmethoxy reserpine. Serotonin, which has an important role in brain function, is said when in the free form to prolong the action of reserpine.

The Rauwolfia alkaloid mixtures used are similar to reserpine, the scientists believe from their studies, in their ability to improve the patients' mental health and in the side effects produced. Only a small percentage of patients in each group showed no improvement.

Psychogenic Rheumatism

➤ **RESERPINE**, relaxing drug now widely used for treating mental illness and high blood pressure, now temporarily relieves the aches, pains, stiffness and crippling in some patients with psychogenic rheumatism.

Good results in a preliminary trial of this new use for the drug

are reported by Dr. Harry Bartfeld of New York in the Journal of the American Medical Association.

He tried the drug because psychogenic rheumatism is believed to come from emotional stimuli of the sort which reserpine might abolish. Psychogenic rheumatism is not uncommon. In one series of 500 consecutive civilian patients it was found in 13.4%.

The drug temporarily relieved the complaints of five out of seven patients with this kind of rheumatism.

With the idea that it might help in other kinds of arthritic diseases, which are known to be made worse by emotional disturbances, Dr. Bartfeld tried it in some more patients. He reports that it brought some temporary relief to five of 16 patients with osteoarthritis and one of four with rheumatoid arthritis.

Relaxing Drug Dulls Pain

➤ **ONE OF** the most agonizing disorders of the body, the excruciating pain on the whole side of the body which occasionally follows a stroke, apparently can be alleviated by chlorpromazine, a drug used in treating the mentally ill.

Successful alleviation of the pain in a 41-year-old housewife for nearly a year and a half has been reported by two psychiatrists at the University of California Medical Center, Dr. Lester

H. Margolis and Dr. Alfred Gian-
ascol.

Earlier trials of the drug against
the condition, called the thalamic
pain syndrome, apparently were
unsuccessful because of relatively
small doses used.

Thalamic syndrome, a relatively
rare condition, is marked by ter-
rible, burning pain throughout
the side of the body affected by
the stroke. Damage to the brain
connections by the stroke is the
cause.

Patients are sometimes driven
by the constant, unbearable pain
to attempt suicide, to drug addic-
tion, or to beg for lobotomy, a
brain operation which dulls pain
reactions but may cause undesir-
able personality changes.

Chlorpromazine was tried on
the housewife when she was hospi-
talized after her fourth suicide
attempt and after all other drugs
failed to bring relief. The doctors
began to get a good response with
200 milligrams per day of the
drug, and learned eventually that
400 milligrams gives the best re-
sults. This is several times larger
than the doses of earlier trials.

The pain is still present to a
moderate degree, but it has not
interfered with the patient's
household work.

New Drug Stops Trembles

► A DRUG that stops the finger
trembling caused by some tran-
quilizing drugs has been found.

The drug and the reason why it
is effective were reported by Drs.
Harold E. Himwich and Franco
Rinaldi of the Galesburg, Ill.,
State Research Hospital at the
meeting of the American Associa-
tion for the Advancement of Sci-
ence.

The drug is benztropine meth-
anesulphonate, trade named Co-
gentin. It combines the effects of
atropine and the anti-histamine,
diphenhydramine, or Benadryl.

The finger trembling it controls
is one of the abnormalities seen in
parkinsonism, or shaking palsy as
it is popularly known. When it hit
patients getting chlorpromazine
or reserpine for mental sickness,
the doctor had to stop these drugs
or at least reduce the dose, but
this made them less effective in
controlling the mental illness.

Now, according to the Gales-
burg researchers' findings, the
new drug can be given to counter-
act the parkinsonism, or trem-
bling, while the patient goes on
taking the tranquilizing drug to
relieve his mental symptoms.

The trembling, or tremors, are
due, rabbit studies suggest, to a
stimulating effect of chlorproma-
zine and reserpine on the reticu-
lar formation. This is a structure
which extends throughout the
central core of the brain and
exerts control over the motor ac-
tivity of the body. Atropine and
similar drugs depress the activity
of the reticular formation and that

may be the reason why they improve abnormal muscular function of patients with parkinsonism. The Galesburg researchers show that the new atropine-like drug, Cogentin, is particularly effective in depressing the abnormal activity of the reticular formation.

These drugs not only improve the physical disability of the patients but also their subjective feelings so that the patients feel much better whether or not their motor disabilities are entirely cured.

Meprobamate

► A NEW tranquilizing drug called meprobamate is calming belligerent mental patients, helping alcoholics through the sobering-up process and relieving tension headaches, muscle spasm and other nervous states in less severely ill patients.

Reports on its good results with alcoholics and mental patients were given at a meeting of the American Association for the Advancement of Science.

Of 301 disturbed mental patients, 33 have been returned to their homes as a result of treatment with this drug, Dr. Veronica M. Pennington of Mississippi State Hospital at Whitfield, Miss., reported. Another 29% have greatly improved, 50% show some improvement and in 18% very little change is evident.

She found this new drug safe with almost complete lack of side effects, except for low blood pressure when large doses were given.

Patients must go on taking the drug in order to continue mentally healthy, just as diabetics usually must continue to take insulin to remain well. Of five patients who had gone home but had to return to the hospital, only one had continued to take the drug while at home as instructed.

A quality of this drug not previously reported is its ability to staunch the odor of perspiration. Dr. Pennington reported that four patients who for a year had a "skunk-like odor" which no amount of bathing changed no longer have this disagreeable odor.

More than 74% of alcoholics benefited from the drug during the withdrawal period. Anxiety symptoms were relieved and the shakes lessened, Dr. Joseph Thimann of the Washingtonian Hospital, Boston, reported.

The drug is made by Wallace Laboratories, Inc., New Brunswick, N.J., who call it Miltown.

Unlike other tranquilizers, this drug in normal doses selectively depresses the deeper parts of the brain, calming without dulling the senses, according to animal studies reported by Dr. C. D. Hendley of Wallace Laboratories.

A tiny re-chargeable storage battery having a cell that weighs only one-sixth of an ounce has been developed.

Chemical Attacks on Insect Foes

► IN LIVING systems, the size and shape of the molecules in a chemical compound may be more important than their composition. This is the finding of Prof. Herbert C. Brown of Purdue University's department of chemistry.

Germs that need a certain acid in order to grow and multiply will accept in its place a chemical which contains different elements but has the same molecular shape. That is how sulfanilamide works. Its molecule has the same shape as the molecule of para-aminobenzoic acid, and germs, lacking a modern chemical education, accept it in place of the acid. This blocks the germs' metabolism, and the body's defenses against disease have an opportunity to get rid of them.

In insecticides, the same principle is revealed. DDT was thought to be effective against insects because of its chlorine content. But when another compound was tried which had the same shape as the DDT molecule but contained no chlorine at all, it also was a powerful insecticide.

The chemicals hexachloroethane and hexamethylethane are made of different elements, yet they both smell like camphor. The reason for their similar odor evidently lies in the fact that their

molecules are the same architecturally.

Working with highly-reactive chemicals within an all-glass high vacuum system so that air and moisture cannot get to them, Prof. Brown is measuring the effects of molecular shape differences on the heat of chemical reactions. Ultimately, he hopes to come up with a formula that expresses this theory precisely, so that chemists will have a new tool with which to predict possible uses of various chemicals and drugs, insecticides, and other benefits to mankind.

Filters Against Nerve Gas

► THREE NEW filter materials for gas masks and respirators have been found effective against the insecticide demeton, an offspring of the nerve gases developed under Hitler, and formerly too dangerous for widespread farm use.

Probably other agencies of the Government are testing the filters for possible use as protection against gases that might be used against U.S. troops in the future.

The new filters are the first to offer farmers complete protection against all commonly used insecticides. Chemists and entomologists who tested the materials at the Department of Agriculture so report.

The filter materials are: a special grade of fine-fiber asbestos, a fine-fiber wood pulp, and glass wool impregnated with a special resin. All three are now available commercially.

Breaks Down Defenses

➤ "COUNTERFEIT" DDT added to the standard insecticide may offer the means to break through the protective mechanism of DDT-resistant insects.

Hunting for more effective DDT-like chemicals, four Israeli scientists prepared a chemical group with a structure similar to DDT, called the diaryl-(trifluoromethyl)-carbinols. Alone, the new chemicals were not much good as insecticides. But when added to DDT, they caused it to give much higher kills of DDT resistant flies.

To explain the chemicals' effect the researchers suggest that once in the flies' bodies, the "counterfeit" DDTs may preferentially fill up the sites where resistant flies are able to inactivate DDT. Once these sites are filled by the other chemicals, the true DDT is left free to perform its lethal job just as it does in non-resistant flies.

Ernst D. Bergmann of the scientific department, Israeli Ministry of Defense, and A.S. Tahori, A. Kaluszyner and S. Reuter of the Israeli Defense Forces Medical Corps reported these experiments.

Shrimp Test For Poisons

➤ EXPERTS faced with the problem of detecting minute amounts

of poisonous insecticides hidden in vegetables, milk and meat have hit upon an ingeniously simple tool that shows up insecticides diluted a hundred million times.

For the test, U. S. Department of Agriculture scientists use tiny brine shrimp, commonly used as food for tropical fish. A few fertile brine shrimp eggs are shaken into a container of salt water, and the shrimp hatch out within 24 hours. After letting them grow a while, the shrimp are placed in the solution to be tested. Presence of insecticide residue is indicated by changes in the normal swimming habit of the shrimp or by their death.

Brine shrimp can be used to test for chlordane, DDT, lindane, methoxychlor and toxaphene, in solutions containing as little as one part insecticide to a hundred million parts of solution.

Less Harmful if Granulated

➤ DANGER of foods being poisoned with insecticide residues can be cut drastically by using the chemicals in granular form instead of as a semi-liquid spray, research by the U.S. Department of Agriculture and the Iowa Agricultural Experiment Station indicate.

Testing the effects of insecticides on the destructive European corn-borer, experts found that granular forms left 100 to 200 times less residue on corn leaves than did emulsion sprays, while

doing as good or better a job controlling the pest.

Toxic insecticide residue can accumulate in the body fat of livestock or be found in the milk of dairy cows that feed on treated plants.

The insecticides DDT, EPN, heptachlor and malathion have been tested in granular forms, which are made by "fastening" the chemicals to a clay-like material, attapulgit, or to tobacco particles. Unlike sprayed droplets which stay where they fall, the granular insecticides do not cling to the leaf surfaces but tend to slide down into the leaf whorls and junctures of leaf and stalk, where young corn borers do most of their feeding.

Insecticides Kill Game Birds

► ALERTED by the growing menace of potent chemical insecticides to game birds, U.S. Fish and Wildlife Service experts have been feeding them to quails and pheasants to find out how much of the poisons the birds can take without disastrous results.

Diets containing two hundredths of a percent of DDT did not seem to bother adult quails, but ill effects showed up later, when only 66% of their eggs hatched. At the end of 12 weeks, only about 20% of the hatched chicks (fed a DDT-free diet) were alive.

Stepping up the DDT-dosage by only five thousandths of a percent results in death for all the

adult quails in 45 days of feeding. This same dosage killed all adult pheasants in only 18 days.

Dieldrin-feeding at only one thousandth of a percent was similar to the first DDT test on quail, causing a decrease in hatching and high mortality among newly hatched chicks. The effects of aldrin and endrin on reproduction of the game birds were not clear from the tests.

Aldrin, dieldrin and endrin were all highly toxic to both quails and pheasants. The pheasants refused to eat foods with .025% of any of these poisons. With poison on leaves reduced to .01%, however, they could be induced to eat. All male pheasants died within 10 days after the start of this diet. Female pheasants survived for a longer period, but no eggs were produced.

Earlier experiments have shown that the use of one pound of DDT per acre sprayed over forest or farm fields seems to have no immediate effect on bird population, but five pounds per acre cause a marked decrease. The U.S. Forest Service uses one pound of DDT per acre to spray forests for the destructive timber pest, spruce budworm, claiming that it does no significant harm to wildlife.

In spite of earlier findings, not enough is known about the long-range effects of insecticide-spraying on wildlife, the scientists concluded.

Inventions For the Modern Age

Order copies of patents from the U. S. Commissioner of Patents, Washington 25, D. C., enclosing 25 cents in coin, money order or Patent Office Coupons — but not stamps — for each.

Fluorine Activates Chlorine

➤ DR. EARL T. MCBEE of Purdue University and Dr. James A. Bittles of E. I. du Pont de Nemours and Company, of Wilmington, Del., have invented a method for chlorinating organic compounds by using fluorine as the chlorination activator.

The two scientists state that their chlorination method obviates the necessity for expensive and/or elaborate equipment as has been required heretofore. They also claim that by the employment of fluorine, in a relatively small proportion to the chlorine used, under suitable conditions of reaction, chlorination of organic compounds may be accomplished without light, and if desired, without added heat.

Awarded patent No. 2,716,140, the scientists assigned their patent rights to the Purdue Research Foundation, Lafayette, Ind.

Radiation Shield

➤ DR. WALTER H. ZINN, director of the Argonne National Labora-

tory, Lemont, Ill., received patent No. 2,716,705 for a radiation shield that protects both workers and the surrounding areas from radioactive products produced in nuclear reactors.

The shield is made of a pair of spaced layers of concrete, several spaced layers of wax between the layers of concrete and a layer of wax intermixed with steel shot disposed between each of the layers of wax. The scientist assigned the patent rights to the United States of America as represented by the U.S. Atomic Energy Commission.

Grow Chicks Faster

➤ CHICKS can be made to grow faster if given in their diet some sodium soap of a fatty acid. This was discovered by Dr. Stuart Schott of Cincinnati and Charles M. Ely of Springdale, Ohio, who received patent No. 2,717,209 for their invention.

In one test, they report, chicks fed a diet containing .25% of sodium stearate gained 13.4% more weight after 70 days than chicks on a regular diet. Their method for accelerating the growth of chicks calls for the introduction into the solid food consumed by chicks of from .05% to .50% of the sodium soap of a fatty acid of

from eight to 18 carbon atoms based on the amount of solid foods, air dry basis, supplied. The co-discoverers assigned the patent rights to the National Distillers Products Corporation of Virginia.

Frozen Food Marker

► **HOW TO TELL** when you go to the market whether frozen food has spoiled in the package has been solved by two California inventors, John S. Beckett of Glendale and William J. Marenus of Los Angeles.

The two inventors have created a tell-tale device that changes color if the frozen food within a sealed package has been warmed for a length of time long enough to spoil it. Even if the package is refrozen, the indicator gives its true secret away.

The device, which was awarded patent No. 2,716,065, works with a chemical dye indicator that changes its color irrespective of the contents of the package or outside moisture. The inventors have also provided a color band that indicates what the change of color means in terms of spoilage, so the consumer can act as his own detective. The Californians assigned their patent rights to the Aseptic Thermo Indicator Company of Los Angeles.

Liquid Oxygen Explosive

► **A LIQUID OXYGEN** explosive, described as safe or safer to handle than many conventional explo-

sives, and designed primarily for mining, has been patented. It is the invention of Lester P. Barlow of Stamford, Conn. The liquid oxygen explosives is prepared by mixing finely divided activated carbon, such as "lignin carbon," from pulp mills, with a phosphoric acid solution.

The phosphoric acid, Mr. Barlow claims, makes the explosive fire-retardant. If the carbon contains more than 18% of the acid by weight, the inventor explains, it is so fire-retardant that the explosive cannot be set off even with rifle bullets, blasting caps, fulminate of mercury or Primacord. Below 18%, however, Primacord will set it off. The explosive was issued patent No. 2,723,188 and Mr. Barlow assigned the patent rights to the Glmite Corporation of Stamford.

Photosensitive Materials

► **THE U. S. ARMY** was assigned the patent rights to new photosensitive and phototropic materials invented by Lawrence Suchow of New York. Mr. Suchow's invention, he claims, can be used for making reversible print-out papers for temporary reproduction of documents or photographs, for rapid viewing of negatives as positives and for recording information that is to be erased after a certain time.

The materials are created by heating in the solid state an intimate mixture of finely ground

silver sulfide and mercuric iodide.

Mr. Suchow was awarded patent No. 2,723,914 and he assigned the patent rights to the United States of America as represented by the Secretary of the Army.

Detergent Containing Wiper

➤ **OFTEN**, the first raindrops on an automobile windshield spread the oil film and road dust across the windshield, making it difficult to see the road. To correct this safety hazard, John R. Oishei of Buffalo, N. Y., has invented a windshield wiper that cleans the window with a detergent as it wipes.

A detergent-carrying strip is attached to a conventional wiper squeegee. The strip itself is a replaceable cartridge for the detergent. When it begins to rain and the carrier becomes wet, the detergent dissolves and flows down the squeegee for deposit on the windshield. The amount of the detergent used can be regulated and the entire strip taken off and replaced when the wetting agent has been used. The inventor was awarded patent No. 2,724,139 and he assigned the patent rights to the Trico Products Corporation of Buffalo, N. Y.

Tranquilizing Drug

➤ **A DRUG** to quiet patients in tense and anxious states received patent No. 2,724,720.

The drug is meprobamate, marketed under the trade name,

Miltown. Its inventors, Drs. Frank M. Berger of Princeton and Bernard J. Ludwig of New Brunswick, N.J., state that the compound "not only has exceptional anti-convulsant properties, but it also has, when given in suitable dosage, a marked paralyzing action on voluntary muscles."

In tests with animals it was found that the compounds afford protection from electroshock seizures for several hours. Carter Products, Inc., of New York, awarded the patent rights, states that the drug can be prescribed to combat tension headaches, muscle spasm and some stomach conditions caused by worry.

Concrete Radiation Shield

➤ **DR. LYLE B. BORST**, chairman of the department of physics at New York University, has invented a concrete shield that could protect the crews of atomic-powered ships and planes from harmful radiation.

Dr. Borst's improved shielding is made from concrete that has mixed with it small masses of solid metals. These can be in the form of steel punchings, iron shot and colemanite, copper discs, nickel balls and chromium pellets or lead shot. Dr. Borst was granted patent No. 2,726,339. He assigned the patent rights to the United States of America as represented by the Atomic Energy Commission.

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Book Condensations

COLLEGE CHEMISTRY: An Introductory Textbook of General Chemistry — Linus Pauling — *Freeman*, 2d ed., 685 p., illus., \$6.00. In this new edition an attempt has been made to increase the clarity and to add to the amount of organic chemistry covered.

A LABORATORY MANUAL OF QUALITATIVE ORGANIC ANALYSIS — H. T. Openshaw—*Cambridge University Press*, 3rd ed., 92 p., \$2.00. The text has been extensively revised and partly rewritten for this edition.

QUALITATIVE ORGANIC ANALYSIS: And Scientific Method — A. McGookin — *Reinhold*, 155p., \$4.50. A scheme originated by the author for teaching qualitative analysis to beginning students in organic chemistry.

THE CHEMISTRY OF PETROLEUM HYDROCARBONS — Benjamin T. Brooks and others Eds. — *Reinhold*, Volume II, 448 p., illus., \$13.50, Volume III, 690 p., illus., \$18.00. A reference work for petroleum engineers and organic chemists.

DIELECTRIC BEHAVIOR AND STRUCTURE: Dielectric Constant and Loss, Dipole Moment and Molecular Structure — Charles Phelps Smyth — *McGraw-Hill*, 441 p., illus., \$9.00. Discussing the

relations between dipole moment and molecular structure.

MICROWAVE SPECTROSCOPY — C. H. Townes and A. L. Schawlow—*McGraw-Hill*, 698 p., illus., \$12.50. Concerned primarily with a relatively new field, the microwave spectroscopy of gases.

THE ALUMINUM DATA BOOK — G. W. Birdsall, Ed. — *Reynolds Metals Company*, 220 p., illus., paper, ring binding, \$1.00. Technical information about the metal and its alloys.

CHEMICAL ENGINEERING COST ESTIMATION—Robert S. Aries and Robert D. Newton—*McGraw Hill*, 263 p., illus., \$6.00. Intended to help engineers give management economic perspective on a given project.

ANTI-COMPOSITION TABLES FOR CARBON COMPOUNDS (CH, CHO, CHS, & CHOS) — Compiled by H. H. Hatt, T. Pearcey and A. Z. Szumer — *Cambridge University Press*, 191 p., \$4.00. To help chemists recognize and analyze unknown organic chemical compounds of high molecular weight and to express them as formulae.

PHYSICAL CHEMISTRY — Scott L. Kittsley — *Barnes & Noble*, College Outline Series, 209 p., illus., paper, \$1.50. An aid for quick review of the subject. Includes a tabular index to leading standard textbooks.

Proudly Presented

► WATER and waste treatment systems are described in Technical Paper No. 64 of the Milton Roy Co. Use of controlled volume pumps to meter chemicals and additives is described, as well as such processes as coagulation, clarification, boiler water treatment and oxygen scavenging by addition of hydrazine. For further information write the company at Station L, 1300 East Mermaid Lane, Philadelphia 18, Pa.

► CONCRETE blocks, mortar, plaster, stucco and concrete treated with 2% to 4% of Losorb, the moisture proofing additive, are claimed to show less cracking and shrinkage. The additive is also claimed to act as a lubricant in molding and to protect steel framing from corrosion. For further information write Jack L. Wilson, Pennsylvania Chemical Corp., Clairton, Pa.

► IN ORDER to design dynamical systems it is necessary to know how these fluid masses respond to alternating pressure and how they can be represented in the equation of motion of the instrument parts. For a discussion of these problems, the Statham Laboratories, Inc., 12401 West Olympic Boulevard, Los Angeles 64, Calif. offers its technical publication "Alternating Flow of Fluid in Tubes" as Instrument Notes No. 30.

► FLUIDS and lubricants which are derivatives of polyalkylene-glycol are used as rubber and textile lubricants, heat transfer fluids, anti-foam agents, solvents and formulation compounds. Their characteristics differ from those of animal, vegetable and mineral oils. They are described in booklet 6500D by Carbide and Carbon Chemicals Co., 30 East 42nd St., New York 17, N. Y.

► THE DIMETHYL ester of acetone-dicarboxylic acid is offered as a versatile chemical intermediate in the preparation of drugs, insecticides, dyestuffs, chelating agents, amino acids and other complex chemicals. More reactive and less expensive than ADA, the parent chemical, the new DMADA is a white, viscous liquid, latest of the fermentation-based industrial chemicals produced by Chas Pfizer and Co. A comprehensive data sheet, No. 515, and samples are available from the company's Chemical Sales Division, 630 Flushing Ave., Brooklyn 6, N. Y.

► X-RAY diffraction has solved problems of corrosion in pipes, welding fluxes, aluminum bronze catalysts, and maintaining uniformity in aluminum foil. Reprints of an article describing actual cases may be obtained by writing C. J. Woods, Research and Control Instruments Division, North American Philips Co., 750 S. Fulton Ave., Mount Vernon, N. Y.

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